

# Claims

- [c1] A method of patterning a magnetic tunnel junction (MTJ) stack comprising;  
forming an MTJ stack having a free layer, a pinned layer and a tunnel barrier layer disposed between said free layer and said pinned layer;  
masking a first area of said MTJ stack while exposing said free layer of said MTJ stack in a second area;  
rendering said free layer electrically and magnetically inactive in said second area.
- [c2] A method as claimed in claim 1, wherein said stack is formed over one or more interlevel dielectric layers in which one or more respective metal conductor layers are disposed.
- [c3] A method as claimed in claim 1, wherein said free layer is rendered electrically and magnetically inactive through conversion to an inert compound by chemically altering its composition.
- [c4] A method as claimed in claim 3, wherein said free layer is chemically altered by plasma treatment.

- [c5] The method of claim 4, wherein said plasma treatment includes plasma oxidation.
- [c6] The method of claim 5, wherein said plasma oxidation is performed at an elevated temperature that is higher than room temperature.
- [c7] The method of claim 5, wherein said plasma oxidation is performed at a reduced temperature that is lower than room temperature.
- [c8] The method of claim 5, wherein said chemical alteration further includes acceleration of oxygen ions.
- [c9] The method of claim 3, wherein said free layer is chemically altered by exposure to a chemical agent including at least one agent selected from the group consisting of fluorine, carbon, and nitrogen.
- [c10] A method as claimed in claim 1, wherein said free layer is rendered electrically and magnetically inactive through oxidation.
- [c11] The method of claim 3, wherein said free layer is chemically altered by anodization.
- [c12] The method of claim 1, wherein said free layer is rendered electrically and magnetically inactive by physically altering its composition.

- [c13] The method of claim 12, wherein said free layer is rendered electrically and magnetically inactive by adding additional atoms to said free layer.
- [c14] The method of claim 12, wherein the additional atoms are added by ion implantation.
- [c15] The method of claim 1, wherein said free layer includes a layer consisting essentially of nickel-iron (NiFe).
- [c16] The method of claim 12, wherein the additional atoms are added by diffusion out of an adjacent "donor" film into said free layer of at least one agent selected from the group consisting of oxygen, nitrogen, fluorine, and carbon.
- [c17] The method of claim 1, wherein said masking is conducted by forming a hardmask including at least one material selected from the group consisting of titanium nitride (TiN), tantalum nitride (TaN), and a sacrificial material, wherein said free layer includes iron, and said tunnel barrier layer includes at least one material selected from the group consisting of aluminum oxide and magnesium oxide.
- [c18] A method of patterning an MTJ stack of a magneto-resistive random access memory (MRAM) comprising;

forming an interlevel dielectric layer (ILD) over a substrate, said ILD including a plurality of conductive lines and vias;

forming an MTJ stack overlying said ILD, said MTJ stack including a pinned layer, a tunnel barrier layer overlying said pinned layer, and a free layer overlying said tunnel barrier layer;

masking a portion of said MTJ stack to expose an area of said free layer; and

converting said exposed area of said free layer to a non-magnetic compound by altering its composition.

[c19] The method of claim 18, wherein said exposed area is also rendered highly resistive.

[c20] A structure including a magnetic tunnel junction (MTJ), comprising:

an MTJ stack including a first portion of a pinned layer, a first portion of a tunnel barrier layer overlying said first portion of said pinned layer, and a free layer overlying said first portion of said tunnel barrier layer; and

a layered stack abutting one or more peripheral edges of said MTJ stack, said layered stack including a second portion of said pinned layer, a second portion of said tunnel barrier layer, and an electrically and magnetically inactive compound of a material included in said free layer.

